



SERC ENERGY NEWS

California's First Rural Hydrogen Station Debuts Richard Engel

Fall 2008
Volume 3, Number 3

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The quarterly newsletter of the Schatz Energy Research Center

HUMBOLDT STATE UNIVERSITY

Three years of effort at SERC culminated on a sunny September 4 with the opening ceremony for our newly completed hydrogen fueling station on the Humboldt State University campus. On hand for the ceremony were Congress member Mike Thompson, representatives of local government, a wide cross section of the campus community, and many camera- and notebook-toting reporters.



SERC Director Peter Lehman cuts the ribbon as Congr. Mike Thompson, HSU President Rollin Richmond, and Project Manager Greg Chapman look on (left to right). Below, Greg Chapman pulls the hydrogen-powered Prius into the station for a demonstration refueling. *Photos by Kellie Brown, HSU Marketing & Communications.*

The project originated with a design for a hydrogen power park by HSU engineering students that garnered grand prize in an international competition in 2005. Since then, SERC has worked with numerous partners to make the station happen. Many members of the original student team were on hand at the ceremony to see their dream come to fruition.

The new station is the northernmost link in California's emerging Hydrogen Highway, a network of hydrogen stations that will eventually allow motorists to travel throughout the state on clean hydrogen power. The station uses a Hogen electrolyzer made by Proton Energy Systems to generate hydrogen gas at 200 psi. A PDC compressor pressurizes the gas to 6000 psi for storage, and it is transferred to vehicles at up to 5000 psi using an FTI dispenser. The detailed station design and assembly were the work of SERC engineers and project manager Greg Chapman, P.E. "We're very proud of our work and are excited to demonstrate the use of hydrogen gas as a transportation fuel right here on campus," said Chapman.



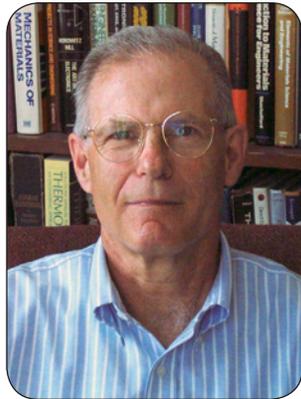
The station is initially providing fuel for a Toyota Prius hybrid, converted by Quantum Technologies to run on hydrogen. The car was *(continued next page)*

SERC would like to thank our sponsors and partners in building the HSU Hydrogen Fueling Station.
Chevron Technology Ventures • California Air Resources Board California Department of Transportation • North Coast Unified Air Quality Management District • O&M Industries • HSU Plant Operations personnel • Urfer Engineering • Winzler & Kelly • Deputy State Fire Marshall Ed Madden

A Message from the Director

Peter Lehman

The big news for the Schatz Center this month is the official opening of the HSU hydrogen fueling station. As reported by Richard Engel in this issue, we had a joyous grand opening ceremony on a beautiful Humboldt County day. After almost two decades of installing hydrogen projects scattered all around the U.S., it has been especially rewarding for us to bring our technology home.



Support for our hydrogen work locally has been strong. Local governments, transit agencies, public agencies like CalTrans, and local citizens are all enthusiastic. We hope this will be the beginning of a hydrogen transportation infrastructure in Humboldt County and that we can serve as a role model for other regions.

Richard also reports on our highly successful UNPEPP interns who worked with Redwood National and State Parks to improve the energy efficiency of park headquarters in Crescent City. This is the sixth year we've had an UNPEPP program and the three undergraduate engineering students did a bang-up job researching and reporting on efficiency improvements.

Also in this issue, grad student Kristen Radecky reports on her work with fellow student Peter Johnstone to research off-grid lighting in Kenya. Working with Professor Arne Jacobson, Kristen and Peter are trying to determine the extent to which very efficient LED lights can replace dirty and costly kerosene lighting. Such a change would have both health and global climate benefits. You'll also find updates about our efforts to develop wind and hydropower for the Yurok Tribe and our ongoing gasification research.

As I write this, our presidential race is in full swing. Both candidates have taken serious and responsible positions on the need to address climate change and it seems that our nation is poised to finally take meaningful action. We look forward to working with the new administration to advance clean and renewable energy technologies.

Hydrogen Station *(continued from first page)*

provided by the California Air Resources Board and will be shared by administrators from Humboldt State University, SERC, and other project sponsors (see box on first page). SERC is working to secure additional vehicles for use with the station.

SERC Returns to Redwood National Park

Richard Engel

Three HSU students spent their summer as SERC interns helping to reduce environmental impacts at Redwood National and State Parks. Funding for the collaboration was provided by the nationwide University-National Park Energy Partnership Program (UNPEPP). UNPEPP links national parks with university students to provide energy services to the parks and real-world problem solving opportunities for the students. This was SERC's sixth UNPEPP-supported project at the Redwood parks since 2000.

The students, environmental resources engineering majors Jeffrey Hinton, Teresa Persons, and Lucas Siegfried, developed a detailed plan to make the park's Crescent City headquarters more energy efficient. They also designed a solar electric system to offset the building's electric bills and helped the park to enroll in a national Climate Friendly Parks program.

At the close of their project, the students gave a presentation detailing their findings and recommendations to an enthusiastic audience of park rangers and administrators. The energy saving measures recommended by the students would save the park nearly \$8,000 a year on utility bills and pay for themselves in less than one year. Their utility-connected rooftop solar system design could generate more than enough electricity to power the entire building. The students' emissions inventory determined that vehicles operated in the park are the chief source of greenhouse gases at Redwood.

The interns enjoyed a strong working relationship with personnel at Redwood. "The park staff is very pleased with the professional way Teresa, Jeffrey and Lucas conducted themselves and the outstanding data that they captured on energy use at our headquarters building," noted Chief of Facilities Management Ray Cozby. "We are implementing many of their recommendations immediately and are pursuing funding for others. We look forward to significant savings on utility costs as well as lowering our overall carbon footprint."

"Being an UNPEPP intern was a wonderful experience," said Lucas Siegfried. "I gained a lot of real world knowledge about networking and getting a job done."



Redwood National and State Parks Chief of Facilities Management Ray Cozby with energy interns Jeffrey Hinton, Lucas Siegfried, and Teresa Persons

Off-Grid Lighting Research in Kenya

Kristen Radecsky

SERC co-director Dr. Arne Jacobson and graduate student research assistants Peter Johnstone and Kristen Radecsky traveled to Kenya this past summer to collect data for the off-grid lighting project. Lighting is often a large fraction of the operating costs for small, off-grid businesses in Kenya. Because they are not connected to the grid, they use a variety of off-grid lighting technologies to illuminate their shops— including candles, kerosene lamps, and battery powered LED lamps. Kerosene lamps are most popular, but can be expensive due to high kerosene prices. Kerosene lamps can also release tiny particulate matter that causes health problems. A number of manufacturers world-wide are designing off-grid lighting products with the goal of making them more affordable in locations like Kenya, often using LED technology. SERC researchers will use the collected data to inform manufacturers of the costs for small businesses of using off-grid lighting products in actual field conditions and make recommendations for how lights can be better designed to make them more affordable.

To learn how lighting products are used in Kenya, the researchers teamed up with Kenyan electrician, Maina Mumbi, to collect data in two towns: Maai Mahui and Karagita. The team surveyed over 50 small businesses on their current lighting uses and spent five-to-seven nights carefully measuring the kerosene consumption for each vendor's lamp. With the data, the team calculated vendor's true operating costs for using kerosene lighting and estimated operating costs for other lighting alternatives such as LED-based off-grid lighting products.

In addition, the research team deployed 14 data-logging rechargeable LED lamps between the two investigated towns. The lamps were assembled by SERC using LED lighting components

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Kristen Radecsky measures a vendor's hurricane lamp to calculate the lamp's burn rate.



Street vendors in Maai Mahui illuminated by a pressurized kerosene lamp.

Project Updates

Yurok Wind & Hydro Study Jim Zoellick

SERC has been assisting the Yurok nation with energy related projects since 1999. Our current collaboration is to examine the feasibility of developing hydroelectric and wind power resources on the Yurok Reservation. To date, three project sites have been selected and data monitoring equipment is being installed. We will be monitoring stream flows on both Cappell and Pecwan Creeks, and wind speeds on McKinnon Hill.



We are currently working with the Tribe to install stream gauging stations on the two creeks. We are also awaiting arrival of a 50-meter meteorological tower from the National Renewable Energy Laboratory that we will install on McKinnon Hill. We plan to have all three data collection systems up and running by the end of the year. We will collect data for a one-year period and will assess the data and determine the feasibility of installing energy generation equipment at these sites. Our work will include life cycle economic analyses; preliminary economic assessments; and the development of business, financing, and project development plans. Watch our future newsletters for project updates.

SERC engineers Mark Rocheleau and Richard Engel work with Tribal Planner Austin Nova to install a stream gauging station on Cappell Creek.

Biomass Gasification Ranjit Deshmukh

We have successfully completed the first phase of our three-year Indonesian Gasification project in collaboration with the Renewable and Appropriate Energy Laboratory of the University of California, Berkeley. The project is designed to provide support and advice to the Indonesian Sugar Group (ISG) to play a role in the emerging clean energy markets.

During the first year of the project, we focused on two main areas. The first one included a preliminary study of low carbon bio-fuels and identifying opportunities for the ISG to market their low carbon ethanol. The second one is associated with the combined sale of renewable electricity and carbon credits. The Indonesian sugar factories are not designed to efficiently generate surplus electricity since they are not connected to the electricity grid. However, once connected to the grid, the factories have the opportunity to generate surplus electricity by installing high-pressure boiler and turbine systems or integrated gasification combined cycle systems. We developed

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Schatz Energy Fellow

We are pleased to welcome Marjorie "Meg" Harper as the 2008-2009 Schatz Energy Fellow. Meg is pursuing a Master's degree in the Energy, Environment and Society Program at HSU. As a Schatz Energy Fellow, Meg is investigating processes of converting woody biomass from forest fuel reduction into energy products. This project mirrors her interests in local energy generation and the development of alternative fuels from what would otherwise be considered waste products. Meg also has a strong interest in appropriate technology development, especially as applied to energy uses. She spent the past summer designing and building solar water heaters at AIDG in Guatemala. Meg received a BS in Environmental Studies from Warren Wilson College and has worked in the field in a number of different capacities including environmental contaminant and wildlife research, as well as experiential environmental education.

Gasification Update *(continued from third page)*

thermodynamic models for different scenarios of sugar factories incorporating high efficiency direct combustion or gasification systems to estimate the electricity export potential for ISG. We also completed a study of carbon markets identifying opportunities for ISG to generate additional revenues via the sale of carbon credits through the Clean Development Mechanism of the Kyoto protocol or voluntary carbon markets.

Finally, the major component of the project is installing and testing a 20kW downdraft gasifier at SERC. We have completed the structure housing the gasifier, and are close to completing the instrumentation, gas cleaning and burner systems. We are also in the process of acquiring bagasse from Texas to test in our gasifier and are actively searching for partners to help test the bagasse in a fluidized bed gasifier system.

Off-Grid Lighting Research *(continued from third page)*

Power. The data loggers are a novel device designed by SERC engineer Scott Rommel and electronics technician Kyle Palmer. The data loggers will record when the vendors use and charge the lamps over the next six months. Vendors will also log their charging costs. Mumbi is currently downloading and sending data logging records to the research team. The team will use the recorded data to estimate true operating costs for LED off-grid lighting products for the small businesses in the study.

Johnstone will return to Kenya for follow-up work this winter. He will bring research results to inform vendors of operating costs for several off-grid lighting options. He may also collect and redistribute data loggers in new SERC lamps for further data collection.

Research results and lamp design recommendations will also be delivered to off-grid lighting manufacturers. Improved lighting designs will ultimately lead to better off-grid lighting products for locations like Kenya.

Looking Back

5 years ago SERC installed a 1.5-kW stationary fuel cell system that helps power the Zweig Education Building at SunLine Transit Agency's headquarters in Thousand Palms, California. The system demonstrates the seamless transfer between fuel cell system power and utility grid power and was designed to be safe, easy to operate, visually attractive, and educational in nature. For more information visit www.schatzlab.org/projects/real_world/zweig.html.



SERC Energy News is published quarterly by the Schatz Energy Research Center at Humboldt State University.

The mission of SERC is to promote the use of clean and renewable energy in our society. SERC meets its mission by performing research and developing new technology; designing, building, operating, and demonstrating clean and renewable energy systems; providing training for professionals; and educating the public about a sustainable energy future. SERC's affiliation with the Environmental Resources Engineering program at HSU provides a rare opportunity for undergraduate and graduate engineering students to acquire hands-on experience with cutting-edge energy technologies.

SERC is a member of the National Hydrogen Association, the International Association for Hydrogen Energy, the International Solar Energy Society, and the American Solar Energy Society.

SERC co-directors are Peter Lehman, Charles Chamberlin, and Arne Jacobson. Research and administrative staff include Andrea Allen, Greg Chapman, Ranjit Deshmukh, Richard Engel, Keith Glenn, Ray Glover, Meg Harper, Peter Johnstone, Patricia Lai, Marc Marshall, Allison Oakland, Joe Purdon, Kristen Radecsky, Mark Rocheleau, Scott Rommel, Colin Sheppard, Michael Winkler, and Jim Zoellick.

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